

**Final Technical Report
Fremont Bridge
Approach Replacement Project**

Air Quality

Revised July 16, 2004

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City of Seattle

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Executive Summary

The Fremont Bridge Approach Replacement Project's principal goal is to replace the existing sub-standard bridge approaches with approaches that meet current structural design standards. Improvements would replace the existing sub structures and superstructures for the north and south approaches, and seismically retrofit and strengthen the north approach off-ramp. Sidewalks and railings on the approach structures would also be replaced.

Localized carbon monoxide (CO) concentrations were modeled for 2002, 2007, and 2030 using standardized Puget Sound Regional Council (PSRC) and Environmental Protection Agency (EPA) modeling procedures. Predicted worst-case one-hour and eight-hour average CO concentrations were evaluated for the project. The operational impacts of other pollutants would be less than for CO. For both the No Action alternative and the Build alternative, the one-hour and eight-hour average CO concentrations would be below the National Ambient Air Quality Standards.

Consideration of construction impacts included particulate matter (PM), oxides of nitrogen (NOx) and carbon monoxide (CO). Construction activities would result in temporary pollutant emissions, including dust and odors. To reduce dust emissions, Best Management Practices (BMP) accepted by the Associated General Contractors of Washington for dust abatement would be used during construction. Air quality impacts and mitigation measures for this project are summarized in the table below.

Table 1: Summary of Air Quality Impacts and Mitigation

Alternative	Construction Impacts	Operation Impacts	Mitigation Measures
No Action	None	Worst-case eight-hour CO concentrations were modeled to be 7 ppm in 2007 and 5.1 ppm in 2030	None required
Build	Construction activities would result in temporary emissions of pollutants	Worst-case eight-hour CO concentrations were modeled to range between 3.9 and 7 ppm in 2007 and 3.5 and 5.4 ppm in 2030	Use of Best Management Practices during construction would control particulate emissions. No mitigation would be required during operation.

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Introduction

The goal of the Fremont Bridge Approach Replacement Project is to replace the existing substandard bridge approaches with approaches that meet current structural standards. This technical report analyzes the existing air quality and potential impacts associated with implementation of the proposed alternative for the Fremont Bridge project.

Project Description

The Fremont Bridge is located in north Seattle and spans the Lake Washington Ship Canal, providing an important transportation link between the Fremont and Queen Anne neighborhoods (see Figure 1). It is a drawbridge with two lanes in each direction for vehicles, with sidewalks for non-motorized users. In 1998, a condition report completed for the approach structures found them to be structurally deficient and functionally obsolete by Washington State Department of Transportation (WSDOT) standards. The study concluded that replacement of the existing bridge approaches was the prudent course of action.

The purpose of this project is to replace the existing sub-standard bridge approaches (located north and south of the bridge itself) with new approaches that meet current structural design standards. The bascule bridge portion will not be affected by this project. The approaches are the elevated roadways at each end of the bridge that connect to city streets. Improvements would replace the existing structures for the north and south approaches, and seismically retrofit and strengthen the north approach off-ramp. Sidewalks, railings and lighting on the approach structure would also be replaced. The new bridge approach structures would be located in the same location as the existing structures. The north and south approach structures have average centerline lengths of 534 feet and 124 feet, respectively.

The project also includes five additional components, which are described in more detail below. These additional project components will not impact the air quality, thus they were not analyzed for air quality issues.

Replacement of Operations and Maintenance Shop

The City of Seattle owns and operates the Fremont Bridge Operations and Maintenance Facility. This building is located underneath the southern approach of the bridge. The facility includes a 6,130 square foot building area (gross square footage), ten parking spaces, and a yard area. The existing building includes an electrical shop and administrative offices. The existing two-story concrete structure would be removed prior to the removal of the eastern half of the southern approach structure. It is likely the demolition of the eastern half of the southern approach structure would take place immediately after the demolition of the Operations and Maintenance Building. The building would be deconstructed, and all material would be disposed of according to the City of Seattle Standard Specifications.

The City of Seattle considered four design options for the new Operations and Maintenance Facility. Through the public outreach process, Scheme 4 became the

preferred alternative. The City of Seattle presented the two design options to the Citizen Advisory Group (CAG) on March 23, 2004. The CAG was in agreement with the City that Scheme 4 was the preferred alternative. In addition, the City presented the preferred alternative at a public open house on May 12, 2004.

The building areas listed below are maximum estimates that are expected to decrease as the project moves through value engineering. The new building areas will only slightly increase in size in comparison to the existing building. The City of Seattle owns the right of way in which the building will be replaced.

In the Scheme 4 design the majority of the parking area would be underneath the bridge approach with a shop building area that is structurally independent of the approach structure. This design includes a separate building with a maximum of 1,160 gross square feet on the first floor and 2,520 gross square feet on the second floor. This building was designed with a larger top floor to create a more environmental-friendly and aesthetically pleasing building as well to provide some covered parking and yard area. This building would be constructed at the east end of the site adjacent to the bridge and an open paved yard of 4,950 square feet and 1,190 gross square feet of covered shed shop area. With the Scheme 4 design, the loading area is separated from the parking spaces on the north side of the lot to allow free access to the majority of the parking yard area.

Upgrade Mechanical and Electrical System

The project would also upgrade the mechanical/electrical system used to raise and lower the drawbridge. Although this work will take place over the Lake Washington Ship Canal, no material will enter the water. The electrical work would include a number of elements. The major components of this work are listed below:

1. Removal and replacement of all existing electrical equipment, motors, controls, conduit and wire. Work will be sequenced and coordinated with structural and mechanical activities to minimize impact to the roadway and waterway traffic.
2. Installation of new service entrance equipment including: meter sockets, current transformer enclosures, and main disconnect circuit breakers at both North and South bascule piers.
3. Installation of two standby engine generator sets, automatic transfer switches and associated equipment. The generators shall be sized for operation of the bascule leaves and for the house lighting and outlets.

In addition, the mechanical system of the drawbridge would be upgraded with the following work elements:

1. Removal of bridge reduction machinery from the platforms on the bascule piers. Removal of line shafts and reduction machinery on each side of each bascule leaf.
2. Installation of new motors, brakes and enclosed reduction machinery on each side of each bascule leaf.
3. Replacement of bridge center lock system.

4. Installation and removal of a temporary bridge operating system consisting of a City-provided winch system, wire ropes and blocks.

Replacement of Existing Pedestrian/Bicycle Stairs

The project is evaluating a proposal to widen the existing stairs from the Burke-Gilman Trail to the northern bridge approach. These stairs will be either replaced in kind or replaced with wider stairs. The current width of the stairs is approximately 3 feet, and the new stairs would be approximately 6 feet wide. The increased width would allow two people carrying bicycles to use the stairs at the same time. This project is not currently planning to change the existing stairs in the vicinity of the southern approach. During construction of the approaches, the current stairs will need to be removed as they are attached to the approach structures. If the stairs are not replaced, the current stairs will be reused to maintain the connection from the Burke-Gilman Trail to the northern bridge approach.

Non-Motorized Related Improvements

To accommodate bicycle users, the Seattle Department of Transportation (SDOT) plans to provide the following bicycle related improvements:

Permanent Improvements

- Widen the southbound curb land between Florentia and Nickerson Streets to 14 feet to create a substantially more street space for bicyclists as they transition from the sidewalk to the street.
- Relocate or remove poles and other vertical obstructions to create a clearer pathway for pedestrians/bicyclists and to eliminate double blind zones at the north and south end of the bridge deck.
- Use signs or other lane-markings devices to help warn drivers and bicyclists of potential conflicts.
- Trim back the northeast traffic island at the Nickerson Street and Westlake Avenue intersection to minimize debris collection.
- Provide a bicycle signal for eastbound movements at North 34th Street and Fremont Avenue. The new bicycle signal will be similar to a vehicle signal (with red, green and yellow lights), but it will be slightly smaller in size. A sign will indicate the signal is for bicyclists only.
- Provide a corner mirror at North 34th Street and Quadrant Drive
- Trim back bushes at Florentia Street to improve visibility.

Temporary Improvements

- Provide a temporary six-foot bike lane on the north side of North 34th Street between Stone Way and Fremont Ave North while the Burke-Gilman Trail is closed for construction.
- Place detour signs at locations that will give bicyclists ample opportunity to choose alternative routes during construction.

- Prohibit left turns into and out of the Quadrant complex driveway located beneath the Aurora Bridge during closure of the Burke-Gilman Trail.

To improve bicycle safety and mobility between Florentia and Nickerson Streets the City will acquire a small “sliver” of land on the south side of the Ship Canal. The land is part of a triangle-shaped parcel that is bounded by Florentia Street, Nickerson Street and 4th Avenue North (see Figure 1). The taking of this land may cause the existing espresso stand to be relocated approximately 8 feet to the west. The espresso stand is currently located a few feet into the City of Seattle right of way.

Underwater Cables

Submarine cables currently lay on the bottom of the Ship Canal, which provide power and communications to the north bascule portion of the bridge. These cables have been in place since 1917 when the bridge opened. This project will abandon in place these cables, and it is envisioned the new submarine cable(s) will be laid on the bottom of the Ship Canal and allowed to sink down by its own weight into the mud/silt. It is not expected the original cables will be removed as part of this project. In addition, stormwater facilities for the bridge approaches will be modified to provide oil-water separation and water quality wet vaults as required under the City of Seattle drainage ordinance, Title 22.800 Stormwater, Grading, and Drainage Control Code.

Phasing of Project

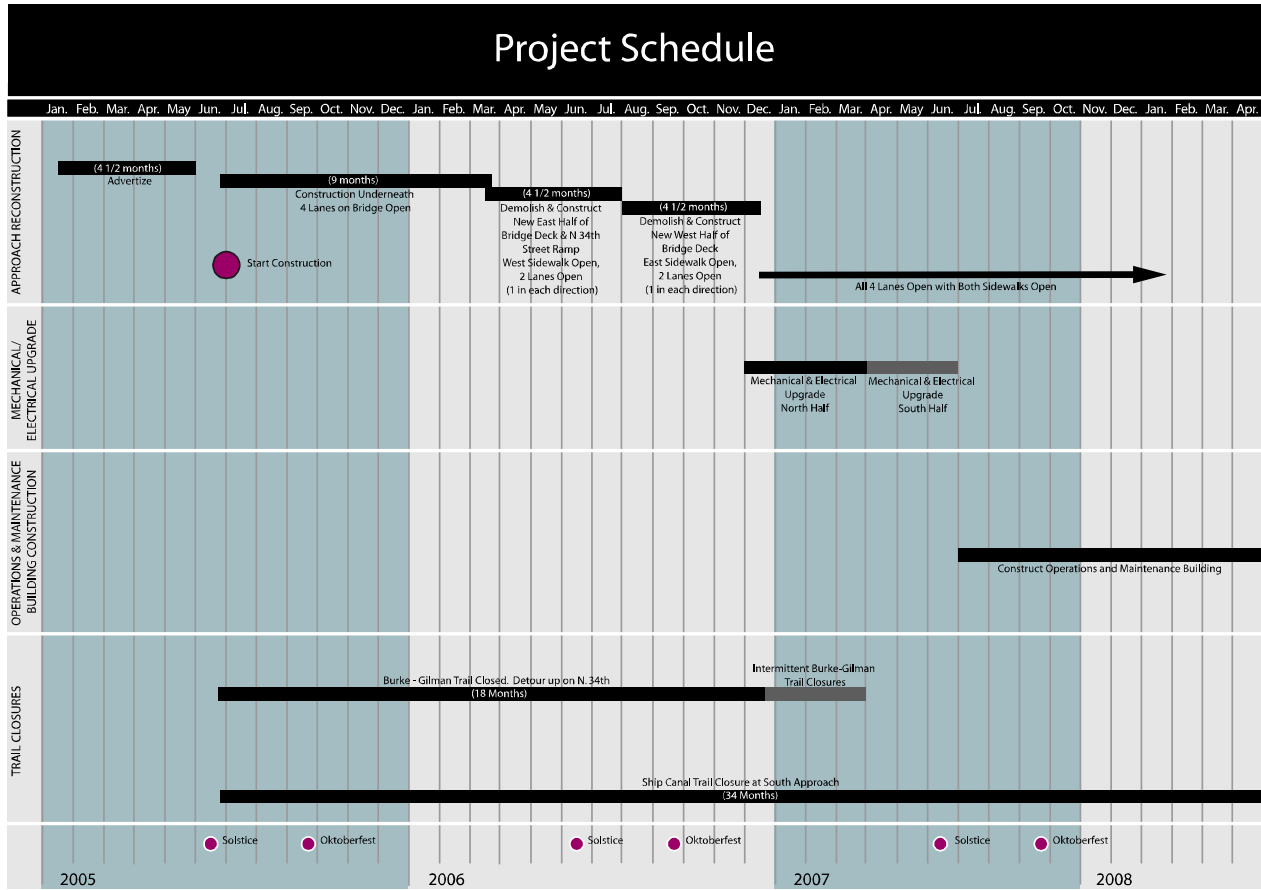
The entire project including all the components will take approximately 30 to 34 months beginning in 2005 (see Table 2 on following page). This time period will include approximately 18 months to replace the approaches as well as an additional six months to complete the construction of the new mechanical and electrical system. The bridge maintenance shop construction will follow the mechanical and electrical system work and will take up to nine months to complete. During approach construction, the project would maintain full bridge operations (two lanes each way and both sidewalks) for approximately the first nine months while constructing a new micro-pile substructure beneath the existing approach structure deck, followed by half bridge closure (one lane in each direction and one sidewalk maintained) for an additional nine months while the approach structure deck is replaced one half at a time.

Up to ten bridge closures may be necessary to replace the north and south approaches. If the upgrade of the mechanical and electrical system is done after the approach replacement, up to four additional closures are possible. Although it is expected that full bridge closures would take place on nights and weekends, it is possible some full closures could occur during weekdays. Any full closures of the bridge during weekdays would be brief. In addition, weekday closures would only take place when it was determined to be more efficient than a weekend or night closure and with community support.

The Burke-Gilman and Ship Canal Trails would be closed in the vicinity of the project due to safety concerns. Users of these trails would be detoured around areas of construction. The City will close the Burke-Gilman Trail for up to approximately 24 months and the Ship Canal Trail for up to approximately 34 months. Once the

approaches are replaced and the mechanical and electrical system work is completed, the City will reopen the Burke-Gilman Trail. The City will reopen the Ship Canal Trail once the new bridge maintenance shop is completed.

Table 2: Project Schedule



The Project Alternatives for Replacement of Approaches

Five build alternatives have been considered for replacement of the Fremont Bridge approaches. To develop and evaluate these alternatives, a *Type, Size and Location Study* was prepared by Parsons Brinckerhoff in March 2003. The post-construction configuration of the approaches and other bridge improvements are the same for all the alternatives. The alternatives vary only in terms of construction methods, project duration, and pedestrian/vehicle access over the bridge or across the Ship Canal during construction. Construction of the approaches is planned to begin in 2005 and is expected to last 18 to 24 months, depending largely on whether or not traffic is maintained on the bridge during construction. All alternatives would require some full bridge closures on nights and weekends. Although it is expected that full bridge closures would take place on nights and weekends, it is possible that some full closures could occur during weekdays. Any full closures of the bridge during weekdays would be brief, and weekday closures would only take place when it was determined to be more efficient than a weekend or night closure. Each alternative is briefly described in the following section. It is important to note that all references to bridge closures include both the north and south bridge approaches.

Alternative 1: This alternative would close the entire bridge for 12 to 24 months while the existing approach structures are completely removed and new approach structures are built on drilled shaft foundations.

Alternative 2: This alternative would consist of one half of the bridge being closed for 18 to 20 months. Half of the existing approach structures would be removed and a new half-structure would be built on drilled shaft foundations, then the second half would be removed and built. During the time period when one half of bridge would be closed, one lane would be open in each direction.

Alternative 3 (the Preferred Alternative): This alternative would support full bridge operations (two lanes each way and both sidewalks) for 9 to 12 months. Construction of a new micro-pile substructure would take place under the existing approach structure deck. While the approach structure deck is replaced one half at a time, half the bridge (one lane each way and one sidewalk) would be closed for 9 to 12 months.

Alternative 4: This alternative would include full bridge operations (two lanes each way and both sidewalks) for 9 to 12 months during construction of a new drilled shaft substructure beneath the existing approach structure deck. Half the bridge would be closed (one lane each way and one sidewalk maintained) for 9 to 12 months while the approach structure deck is replaced one half at a time.

Alternative 5: This alternative would support full bridge operations (two lanes each way and both sidewalks) for 9 to 12 months while constructing a new wall substructure beneath the existing approach structure deck. This would be followed by half bridge closure (one lane each way and one sidewalk) for 9 to 12 months while the approach structure deck is replaced one half at a time.

Alternative 6 (No Action Alternative): In this alternative, the bridge approaches would not be replaced. The City of Seattle may need to close the bridge due to safety concerns because the current bridge approaches are deteriorating.

To determine the preferred alternative, the project team used the following evaluation criteria:

- Maintenance of Traffic
- Construction Cost
- Community Impacts
- Constructability
- Environmental Impacts
- Structural Impacts
- Right of Way Requirements
- Amenities and Aesthetics
- Long-Term Operations and Maintenance
- Overall Construction Impacts

Based on the evaluation criteria, Alternative 3 became the preferred alternative. Most significantly, it would disrupt traffic the least. The alternatives that disrupted traffic the least have been the most heavily supported (over 90%) by the public involvement process to date. Alternatives 1 and 2 would cause the greatest traffic disruptions, so they were dropped from further study. The traffic disruptions from Alternatives 3, 4 and 5 would not be as great. However, Alternatives 4 and 5 scored lower in a number of the other evaluation criteria, so they were precluded from further study. The *Type, Size and Location Study* (Parsons Brinckerhoff, March 2003) includes a more detailed discussion on the evaluation of all the alternatives.

As previously discussed, the alternatives differ only in construction methods, project duration, and pedestrian/vehicle access over the bridge or across the Ship Canal during construction. Because a Preferred Build Alternative has already been identified through the *Type, Size and Location Study*, this analysis compares the Preferred Build Alternative to the No Action Alternative.

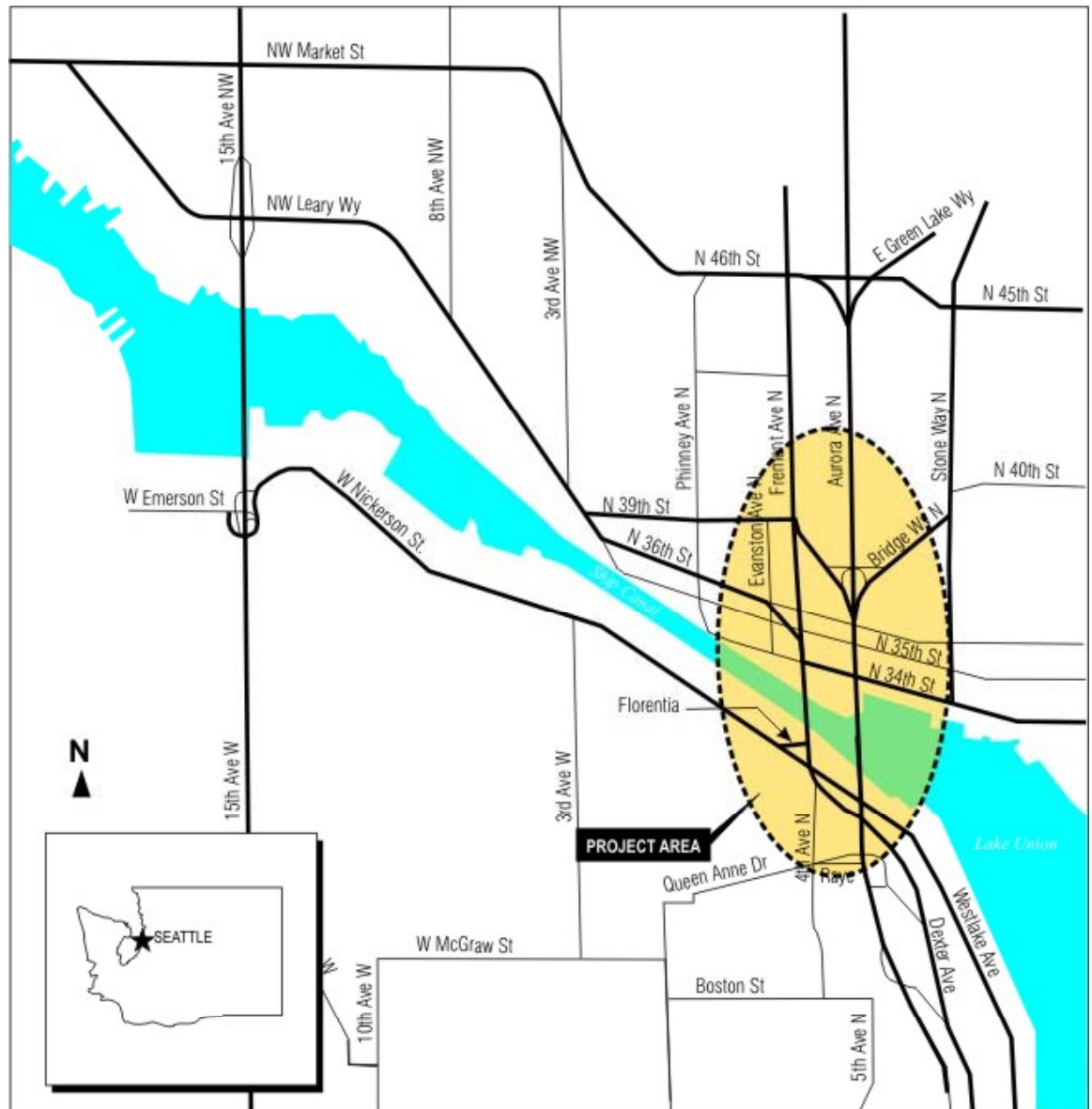


Figure 1. Project Vicinity

Studies and Coordination

Air quality in the project area is regulated by the U.S. Environmental Protection Agency (EPA), Washington State Department of Ecology (WADOE), and Puget Sound Clean Air Agency (PSCAA). Under the Clean Air Act, EPA has established the National Ambient Air Quality Standards (NAAQS), which specify maximum concentrations for carbon monoxide (CO), particulate matter less than 10 micrometers in size (PM₁₀), particulate matter less than 2.5 micrometers in size (PM_{2.5}), ozone, sulfur dioxide, lead, and nitrogen dioxide. These regulated pollutants are referred to as criteria pollutants. The standards applicable to transportation projects are summarized in Table 3.

The eight-hour ozone and PM_{2.5} standards were upheld by a federal appeals court March 26, 2002 following a ruling February 27, 2001, by the U.S. Supreme Court that the Clean Air Act's requirement for EPA to establish national ambient air quality standards (NAAQS) at a level "requisite" to protect public health is within the constitutional scope of discretion that Congress can delegate to a federal agency (*Whitman v. American Trucking Associations*, U.S., No. 99-1257, 2/27/00). Because there is not yet sufficient background monitoring data, the new standards have not yet been implemented by EPA. The one-hour ozone standard will be phased out and replaced by the new eight-hour standard.

The eight-hour CO standard of 9 parts per million (ppm) is the standard most likely to be exceeded as the result of transportation projects. Nonconformance with NAAQS may threaten federal funding of transportation projects in the state.

Nonattainment areas are geographical regions where air pollutant concentrations exceed the NAAQS. Air quality maintenance areas are regions that have recently attained compliance with the NAAQS. The Fremont study area lies within the Puget Sound ozone and CO air quality maintenance areas (Figure 2). Air quality emissions in the Puget Sound Region are currently being managed under the provisions of Air Quality Maintenance Plans (AQMP) for ozone and CO. PSCAA and WADOE developed the current plans, and the EPA approved the plans in 1996. Any regionally significant transportation project in the Puget Sound Air Quality Maintenance areas must conform to the AQMPs. Projects that include the signalization of individual intersections on principal arterials must meet the project-level conformity requirements, but are exempt from regional conformity requirements. The Fremont Bridge Project includes signalization of several new intersections in the vicinity of the bridge.

Conformity is demonstrated by showing that the project would not cause or contribute to any new violation of any NAAQS, increase the frequency or severity of any existing NAAQS violations, or delay timely attainment of the NAAQS.

Table 3: Summary of Ambient Air Quality Standards

Pollutant	National Primary Standard	Washington State Standard	PSCAA Regional Standard
CARBON MONOXIDE (CO)			
One-Hour Average (not to be exceeded more than once per year)	35 ppm	35 ppm	35 ppm
Eight-Hour Average (not to be exceeded more than once per year)	9 ppm	9 ppm	9 ppm
PM₁₀			
Annual Arithmetic Mean	50 µg/m ³	50 µg/m ³	50 µg/m ³
24-Hour Average Concentration (not to be exceeded more than once per year)	150 µg/m ³	150 µg/m ³	150 µg/m ³
PM_{2.5}			
Annual Arithmetic Mean	15 µg/m ³	NS	NS
24-Hour Average Concentration (not to be exceeded more than once per year)	65 µg/m ³	NS	NS
TOTAL SUSPENDED PARTICULATES (TSP)			
Annual Arithmetic Mean	NS	60 µg/m ³	60 µg/m ³
24-Hour Average Concentration (not to be exceeded more than once per year)	NS	150 µg/m ³	150 µg/m ³
OZONE			
One-Hour Average (not to be exceeded more than once per year)	0.12 ppm	0.12 ppm	0.12 ppm
Eight-Hour Average (not to be exceeded more than once per year)	0.08 ppm	NS	NS
Notes: ppm = parts per million µg/m ³ = micrograms per cubic meter NS = No Standard Sources: PSCAA Regulation 1 (1994) 40 CFR Part 50 (1997) WAC chapters. 173-470, 173-474, 173-175 (1987)			

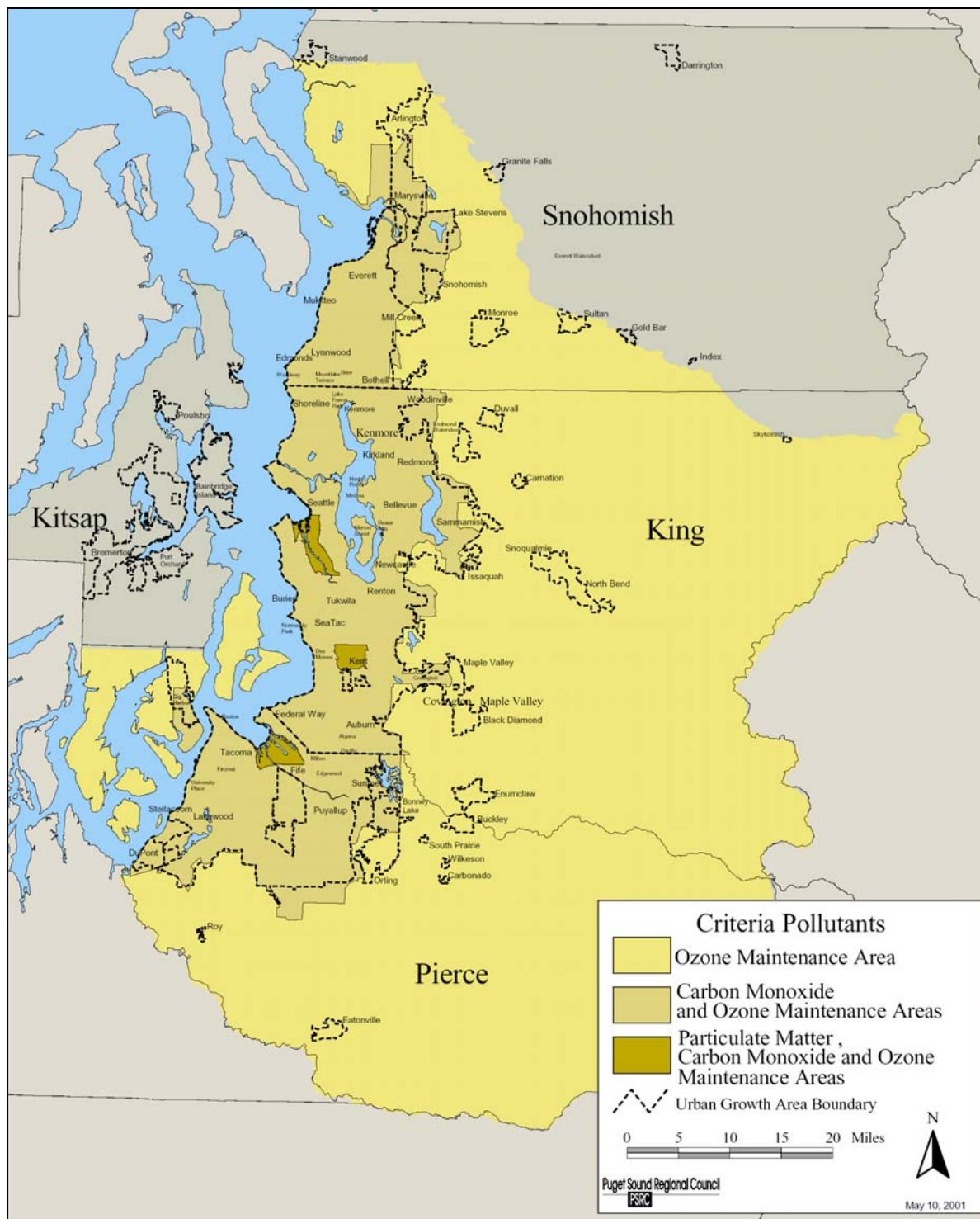


Figure 2. Maintenance Areas

Climate

Weather directly influences air quality. Important meteorological factors include wind speed and direction, atmospheric stability, temperature, sunlight intensity, and mixing depth. Temperature inversions, which are associated with higher air pollution concentrations, occur when warmer air overlies cooler air. During temperature inversions in late fall and winter, particulates and CO from wood stoves and vehicle sources can be trapped close to the ground, which can lead to violations of the NAAQS. In the Puget Sound area, the highest ozone concentrations occur from mid-May until mid-September, when urban emissions are trapped by temperature inversions and followed by intense sunlight and high temperatures.

In 1999, the Department of Ecology replaced their Pollutant Standards Index (a scale of daily concentrations of individual air pollutants) with the Air Quality Index (AQI) that has been standardized by EPA. Using forecast meteorology and real-time pollutant monitoring WADOE and PSCAA forecast the AQI to be one of six levels: good, moderate, unhealthy to sensitive populations, unhealthy, very unhealthy, and hazardous. Since adoption of the AQI in the Puget Sound Region, there have been several instances of air quality in the moderate category.

Between June 1999 and December 2001, air quality was declared “unhealthy for sensitive groups” in western Washington eleven times, most often in Tacoma. It was declared unhealthy in Tacoma once during that period.

Carbon Monoxide

Carbon monoxide (CO) is a colorless, odorless, poisonous gas that reduces the blood’s oxygen-carrying capability by bonding with hemoglobin and forming carboxyhemoglobin, which prevents oxygenation of the blood. Exposure to CO concentrations of 80 ppm over eight hours results in a carboxyhemoglobin level of approximately 15 percent (Erlach, 1977). Acute health effects, such as headaches, slowed reflexes, weakened judgment, and impaired perception begins at about 3 percent carboxyhemoglobin (carbon monoxide bonding with 3 percent of the hemoglobin). Chronic effects include aggravation of pre-existing cardiovascular disease and increased heart disease risk in healthy individuals. At carboxyhemoglobin levels of approximately 30 percent, individuals become nauseous and collapse, and at very high levels (above 50 percent carboxyhemoglobin) individuals die.

The major source of CO is vehicular traffic, industry, wood stoves, and slash burns. In urban areas, motor vehicles are often the source of over 90 percent of the CO emissions that cause ambient levels to exceed the NAAQS (EPA, 1992).

Areas of high CO concentrations are usually localized. They occur near congested roadways and intersections in fall and winter, and are associated with light winds, cool temperatures, and stable atmospheric conditions. These localized areas of elevated CO levels are referred to as hot spots. CO concentration decreases in most areas have resulted from stringent federal emission standards for new vehicles and the gradual replacement of older, more polluting vehicles. CO levels have declined

in urban areas, but are leveling off or increasing in areas experiencing rapid growth in traffic volumes, including remote suburbs in the Puget Sound region.

Particulate Matter

Particulate matter includes small particles of dust, soot, and organic matter suspended in the atmosphere. Particulates less than 100 micrometers in diameter are measured as Total Suspended Particulates (TSP). Particles less than 10 micrometers in size are measured as PM_{10} , a component of TSP. Particles less than 2.5 micrometers in size are measured as $PM_{2.5}$, a component of PM_{10} and TSP. The smaller $PM_{2.5}$ and PM_{10} particles can be inhaled deeply into the lungs, potentially leading to respiratory diseases and cancer because particulate matter may carry absorbed toxic substances, and the particle itself may be inherently toxic.

Particulate matter can affect visibility, plant growth, and building materials. Sources of particulates include motor vehicles, industrial boilers, wood stoves, open burning, and dust from roads, quarries, and construction activities. Most vehicular emissions are in the $PM_{2.5}$ -size range, while road and construction dust is often in the larger PM_{10} range. Most vehicle fine particulate emissions result from diesel vehicles, which release fine particulates both directly, mostly as carbon compounds, and indirectly in the form of sulfur dioxide (SO_2), a gas that reacts in the atmosphere to form sulfate particulates. High $PM_{2.5}$ and PM_{10} concentrations occur in fall and winter during periods of air stagnation and high use of wood for heat. In the Puget Sound Region, fireplaces and woodstoves account for almost two-thirds of winter $PM_{2.5}$ emissions (PSCAA, 1999). On-road vehicle emissions contribute approximately 12 percent of the regions $PM_{2.5}$ emissions, while construction and other dust sources contribute approximately 6 percent.

Particulates emitted from diesel vehicles pose specific health risks when compared to other types of particulate matter. The EPA's Clean Air Scientific Advisory Committee is currently reviewing recent health assessment data on diesel emissions; however, the data is not yet available for citation. Previous EPA research (EPA, 1993) found that components of diesel particulates, primarily high-molecular-weight organic compounds, have several negative health effects, including carcinogenesis, accumulation of particles in the lungs, tissue inflammation, respiratory irritation, and other related effects. Health effects associated with diesel particulates was one of the major contributing factors to establishing the new $PM_{2.5}$ standard.

Ozone

Ozone is a highly toxic form of oxygen and is a major component of the complex chemical mixture that forms photochemical smog. Ozone is not produced directly, but is formed by a reaction between sunlight, nitrogen oxides (NO_x), and hydrocarbons (HC). Ozone primarily is a product of regional vehicular traffic,

point source, and fugitive emissions of the ozone precursors. Tropospheric (ground-level) ozone, which results from ground-level precursor emissions, is a health-risk, while stratospheric (upper-atmosphere) ozone, which is produced through a different set of chemical reactions that only require oxygen and intense sunlight, protects people from harmful solar radiation. In the remainder of this report, the term ozone refers to tropospheric ozone.

Ozone irritates the eyes and respiratory tract and increases the risk of respiratory and heart diseases. Ozone reduces the lung function of healthy people during exercise, can cause breathing difficulty in susceptible populations, such as asthmatics and the elderly, and damages crops, trees, paint, fabric, and synthetic rubber products. The severity of the health effects is both dose and exposure-duration related (National Research Council, 1992). As with PM_{2.5}, the EPA has adopted a new eight-hour ozone standard (see Table 3); however, the old one-hour standard is still applicable for current nonconformity and maintenance areas. Regional ozone planning efforts by PSCAA consider both standards.

In the Puget Sound area, the highest ozone concentrations occur from mid-May until mid-September, when urban emissions are trapped by temperature inversions followed by intense sunlight and high temperatures. Maximum ozone levels generally occur between noon and early evening at locations several miles downwind from the sources, after NO_x and HC have had time to mix and react under sunlight. Light, northeasterly winds arising during these conditions result in high ozone concentrations near the Cascade foothills, to the south and southeast of major cities.

Hazardous Air Pollutants

Other chemicals or classes of chemicals in motor vehicle emissions that are considered hazardous by EPA include benzene; formaldehyde; 1,3-butadiene; acetaldehyde; and gasoline vapors (EPA, 1993). Benzene emissions in the Puget Sound region are substantially higher than the national average. The emissions of all of the transportation-related hazardous air pollutants are much lower than the emissions of the criteria pollutants evaluated in this study, and would vary in a similar fashion to the pollutants presented here.

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Methodology

Predictions of existing and future localized air pollution concentrations in the project vicinity for this and most other roadway air quality studies are made for CO only. Most other pollutants must be monitored and dealt with regionally. This is done for four reasons:

1. Total CO emissions in the atmosphere from automobiles are greater than the emissions of all other pollutants combined; for example, in 2015 an average automobile traveling at 35 mph is expected to emit approximately 13.6 grams of CO per mile of travel, but only 1.5 and 2.2 grams of HC and NO_x, respectively (Mobile 5a results);
2. Motor vehicles are the greatest source of CO emissions, accounting for more than 90% of total CO emissions in urban areas; therefore, it is generally not necessary to account for other, often unquantified, sources of CO near the project area (U.S. EPA, 1993);
3. The complex reactive natures of some of the other pollutants are such that accurate predictions of local ambient concentrations cannot be made using current modeling procedures (Wayne, 1991);
4. CO emissions from motor vehicles may be high enough to affect individuals in the immediate area, while most other pollutants are not (Erlach, 1977).

Average carbon monoxide (CO) peak-hour concentrations (in parts per million: ppm) were calculated using the p.m. peak-hour traffic volumes presented in the Draft Fremont Transportation Analysis using Mobile 6.2 emission factors and CAL3QHC software. CO concentrations were modeled at proposed signalized intersections or at intersections that experience a configuration change in the Fremont Bridge project corridor. Because all new and/or altered intersections were modeled, no intersection screening using level of service (LOS) was done. The five intersections that were modeled are N. 35th Street and Fremont Avenue, N. 36th Street and Fremont Avenue, N. 36th Street and Evanston Avenue, N. 38th Street and SR 99, and N. 38th Street and Bridge Way N. The traffic data used for each model considered the effects of the upstream and/or downstream intersections that may have not been included in the model.

MOBILE 6.2 Model

MOBILE 6.2 is an updated version of the Mobile Source Emission Factor Model computer program developed by the EPA to calculate emission factors from highway motor vehicles in the units of grams of pollutant per mile traveled. Because MOBILE 6.2 accounts for gradual replacement of older vehicles with newer, less-polluting vehicles, the predicted emission rates for future years are lower than current emission rates.

Air quality pollutant emission factors for analysis of the 2002 existing conditions, 2007 and 2030 bridge and no bridge scenarios were estimated using EPA's MOBILE 6.2 emission factor program using data inputs provided by the WADOE. The MOBILE 6.2 emission factors were developed in coordination

with PSRC and WADOE, but do not represent the final MOBILE 6.2 factors that will be adopted for regional conformity analysis by PSRC.

CAL3QHC Model

CAL3QHC Version 2 is a line-source dispersion model that predicts pollutant concentrations near roadways. CAL3QHC input variables include MOBILE 6.2 free flow and calculated idle emission factors, roadway geometries, traffic volumes, site characteristics, background pollutant concentrations, signal timing, and meteorological conditions. CAL3QHC predicts inert pollutant concentrations in ppm averaged over a one-hour period near roadways. CAL3QHC was used to predict CO concentrations at affected study-area intersections.

Carbon monoxide levels were modeled at one existing intersection, N. 35th Street and Fremont Avenue, and four intersections that would be signalized under the Build Alternative including: N. 36th Street and Fremont Avenue, N. 36th Street and Evanston Avenue, N. 38th Street and SR 99, and N. 38th Street and Bridge Way N. (see Figure 3). N. 35th Street and Fremont Avenue was modeled for both the No Action and Build alternatives. N. 36th Street and Fremont Avenue, N. 36th Street and Evanston Avenue, and N. 38th Street and SR 99 are proposed signalized intersections for 2007 and 2030, they were only modeled for the 2007 and 2030 Build Alternative. N. 38th Street and Bridge Way is a proposed signalized intersection that would not be open in 2007, therefore it was only modeled for the 2030 Build Alternative.

CAL3QHC predicts peak one-hour pollutant concentrations based on stable meteorology and peak-hour traffic flow. This study assumed a wind speed of 1 meter (3 feet) per second and evaluated wind directions in 10-degree increments to select the worst-case wind angle. Background CO concentrations were assumed to be 3 ppm averaged over one-hour to represent Puget Sound conditions (Ecology, 1995). An atmospheric stability class of D (urban land use) was modeled per EPA Guidance (EPA, 1992). These conditions usually do not persist for an eight-hour period; therefore, the worst-case eight-hour CO concentrations are lower than the maximum one-hour concentrations. The eight-hour average CO concentration is calculated by multiplying the maximum one-hour concentration by a persistence factor, which accounts for the time variance in traffic and meteorological conditions. EPA recommends a persistence factor of 0.7 (EPA, 1992).

Free-flow traffic was modeled at the posted speed limit. Traffic volumes were obtained from the *Draft Fremont Transportation Analysis* (October 2003). Traffic operations data, including turn movements, signal times, and saturation flow rates were taken from the Synchro runs that were completed as part of the transportation study.

Specific locations where CO concentrations are predicted are known as *receptors*. Receptors are modeled in locations where maximum concentrations likely would occur because of traffic congestion and where the general public would have access (EPA, 1992). For this analysis, receptors were located in areas accessible to the general public at mid-sidewalk distance from the edge of the travel lane and 6 feet off the ground. At each intersection, individual receptors were modeled at the corners and at 50-foot intervals to a distance of 10 feet from the intersection. Only

the highest concentration of CO at each intersection was reported for each modeled scenario.

Typical link and receptor geometry is illustrated in Figure 4.

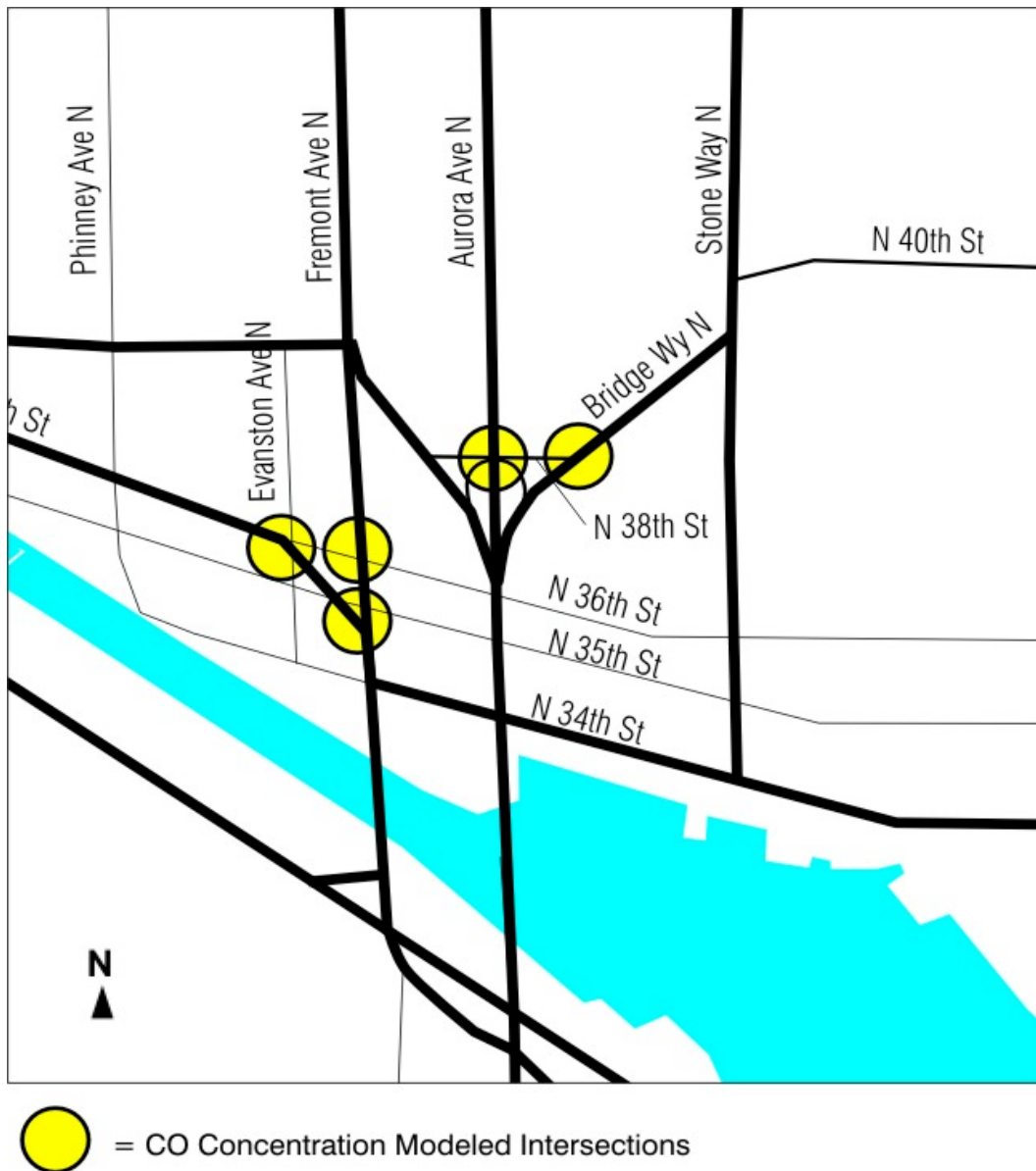
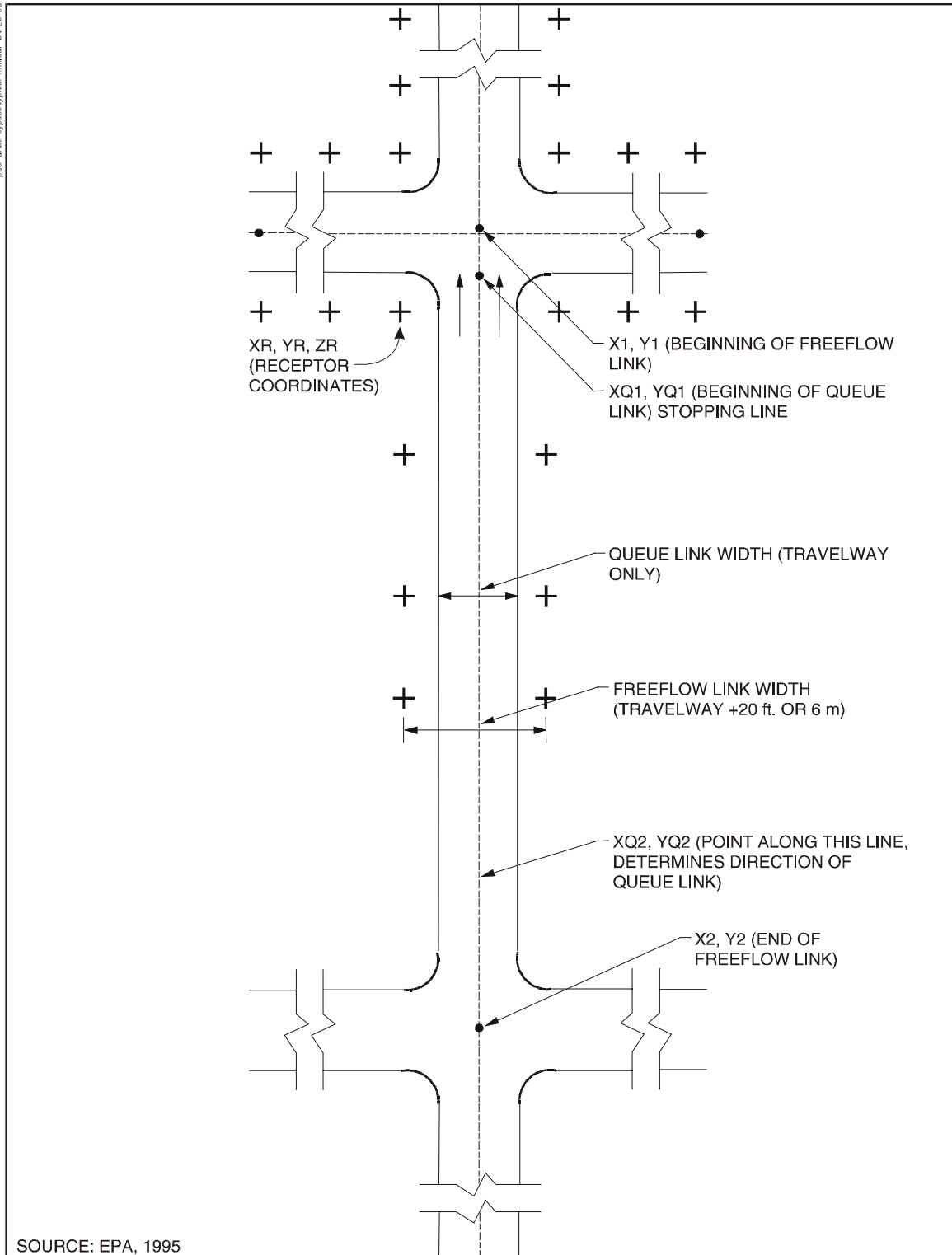


Figure 3. Intersections Modeled for CO Impacts



SOURCE: EPA, 1995

Figure 4. Typical Link and Receptor Geometry

Affected Environment

Description of Study Area

Land use adjacent to the study area is a mixture of residential, commercial, light industrial/manufacturing, and limited undeveloped land.

Emission Trends

Fuel combustion by motor vehicles and other sources releases carbon dioxide (CO₂), which is a “greenhouse gas” that traps heat within the earth’s atmosphere. CO₂ is not directly harmful to human health and is not a criteria pollutant. Considerable progress has been made in the U.S. and in the Puget Sound Region to reduce criteria air pollutant emissions from motor vehicles and improve air quality since the 1970s, even as vehicle travel has increased rapidly.

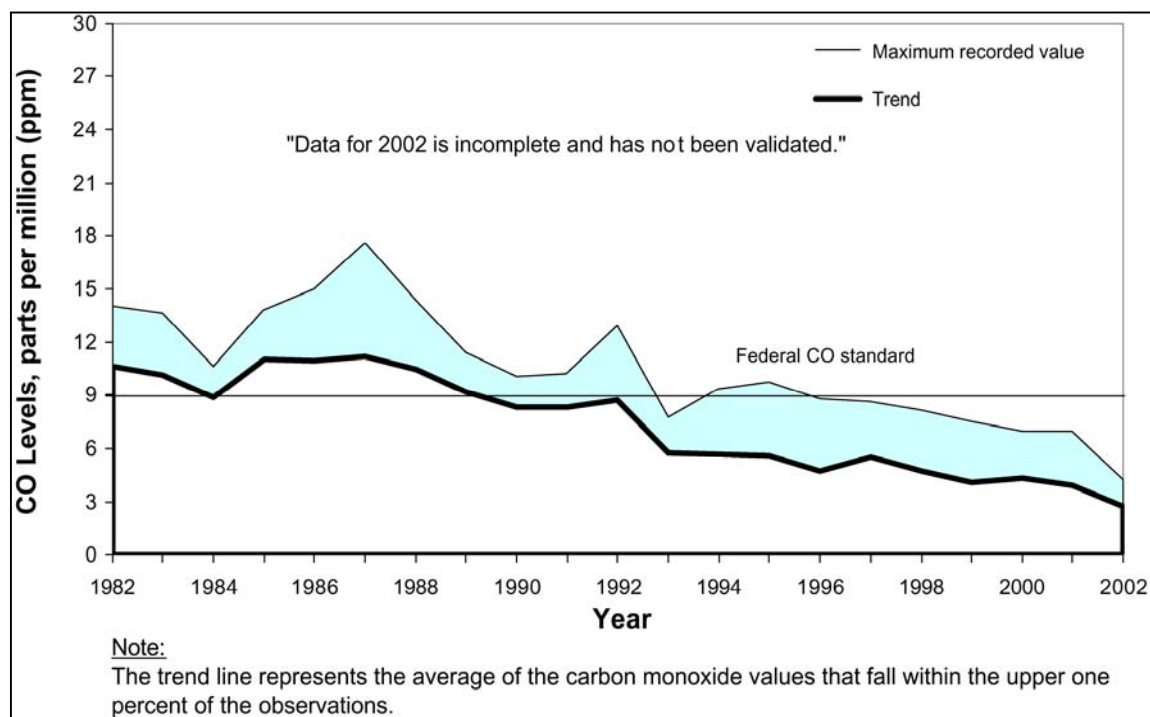
Nationally, emissions of criteria pollutants decreased 25% between 1970 and 2001. In general, the air is noticeably cleaner than in 1970, and all criteria pollutant emissions from motor vehicles are less than they were in 1970, despite the fact that vehicle miles of travel have more than doubled. Still, challenges remain. Based on monitored data, approximately 46 million people in the U.S. reside in counties that did not meet the air quality standard for at least one NAAQS pollutant in 1996 (EPA 1996 and EPA 2002).

National Air Pollution Trends

Nationwide, air pollutant emissions from motor vehicles have dropped considerably since 1970. Volatile Organic Compound emissions (also referred to as hydrocarbon (HC) emissions) are down 38 percent, oxides of nitrogen (NO_x) emissions have increased 15 percent, emissions from particulate matter less than 10 micrometers in size (PM₁₀) are down 76 percent, and carbon monoxide (CO) emissions are down 19 percent. These reductions have occurred along with increasing population, economic growth, and vehicle travel (EPA, 2002).

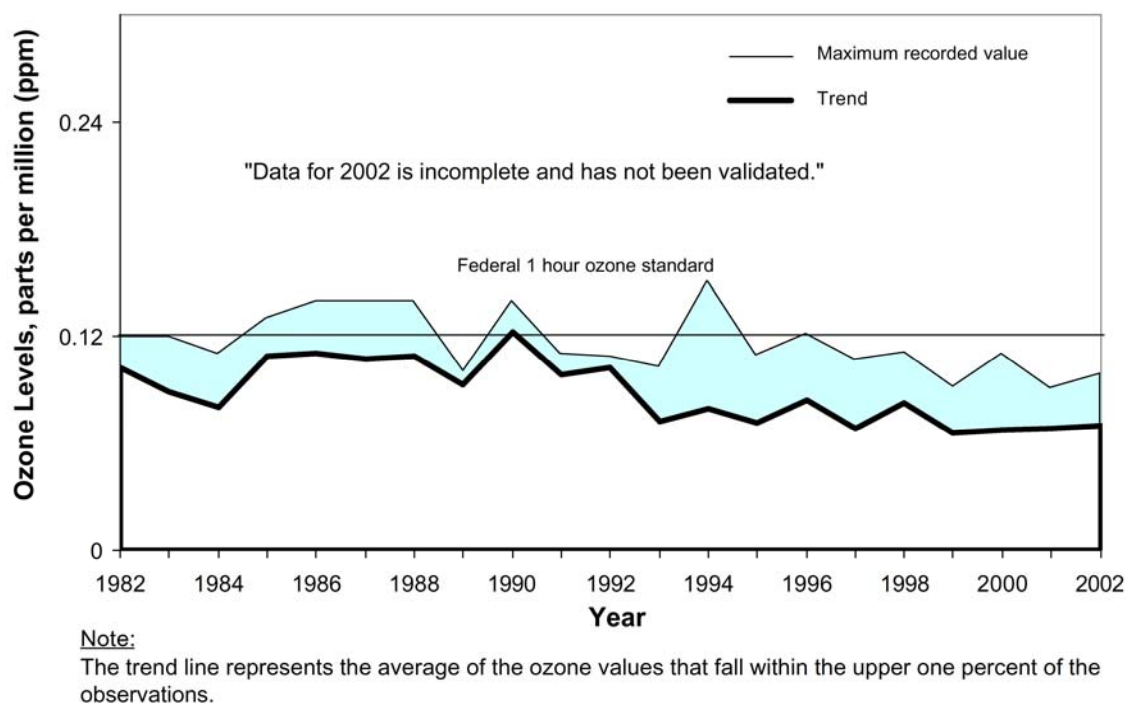
Regional Air Pollution Trends

Regional air pollutant trends have generally followed national patterns over the last 20 years. While the average weekday vehicle miles traveled in the central Puget Sound region has increased from 30 million miles in 1981 to 65 million in 1999 (PSRC, 2000), pollutant emissions associated with transportation sources have decreased. Carbon monoxide (CO) is the criteria pollutant most closely tied to transportation, with over 90 percent of the CO emissions in the Puget Sound urban areas coming from transportation sources. Regionally, the maximum measured CO concentrations have decreased over the past 20 years (Figure 5). Other transportation pollutants have followed similar, but less pronounced trends (Figure 6).



Source: Washington Department of Ecology, 2003

Figure 5. Puget Sound Region CO Trends



Source: Washington Department of Ecology, 2003

Figure 6. Puget Sound Ozone Trend

The Puget Sound Regional Council (PSRC) completed the regional emission analysis, to evaluate the air quality effects of *Destination 2030*, the new Metropolitan Transportation Plan (MTP) for the central Puget Sound region through 2030. The emission analysis includes updates to reflect new EPA emission requirements, including the Tier II Gasoline/Sulfur Rule. The revised emission budget from the latest Air Quality Maintenance Plan (AQMP) and the most recent emission trend modeling are shown in Table 4.

**Table 4: Destination 2030 Regional Air Pollutant Emission Projections
(metric tons per day)**

Pollutant	AQMP Budget	2010 PSRC MTP Forecast	2020 PSRC MTP Forecast	2030 PSRC MTP Forecast
Carbon Monoxide	1,497	860	718	735
Hydrocarbons	248	164	171	202
Nitrogen Oxides	263	206	199	217

Source: PSRC, 2001

Based on the *Destination 2030* analysis, none of the future transportation emissions scenarios is expected to exceed the regional AQMP transportation emission budgets. The downward trend in CO is expected to continue for the Puget Sound region through 2020, but is expected to begin increasing again by 2030 because of increases in vehicle miles traveled. For ozone, the future trend is not as positive. Hydrocarbon emissions, which largely drive ozone formation in the central Puget Sound region, are projected to increase between 2010 and 2020 and continue to increase to 2030. However, hydrocarbon emissions are expected to be below the emissions budget through 2030.

Air Quality Monitoring

Monitoring Results for Criteria Pollutants

The evaluation of existing air quality is based on ambient air quality data collected and published by the Department of Ecology and the Puget Sound Clean Air Agency (PSCAA). WADOE and PSCAA have established air pollution monitoring stations throughout Washington State. In general, these stations are located where air quality problems have been identified. The air quality monitoring stations closest to the Alaskan Way Viaduct And Seawall Replacement Project for CO are in downtown Seattle, approximately 3 miles south of the project area. No exceedances of NAAQS for CO were observed in Seattle location between 1993 and 2002. One exceedance of the eight-hour NAAQS for CO was observed in 1995. Because of the local nature of CO impacts, concentrations measured at this location are not representative of the project site, which could have higher or lower concentrations because of different levels of traffic congestion and roadway configuration.

The Department of Ecology also monitors ozone, and the nearest monitoring station is at Lake Sammamish State Park, approximately 15 miles east of the project area. No exceedances of the NAAQS for ozone were observed at this location between 1994 and 1997. One exceedance in 1998 and three exceedances in 1999 were observed. There were no exceedances in 2000, 2001, or 2002.

The Puget Sound Clean Air Agency operates particulate monitors for PM₁₀ and PM_{2.5} in the Duwamish industrial area. There have been no recorded exceedances of the NAAQS for either PM₁₀ or PM_{2.5} since PSCAA began monitoring for PM_{2.5} in 1999.

During 2000, the EPA, WADOE, and PSCAA conducted air quality monitoring in the Georgetown area (southeast of the Fremont Bridge Project) for 18 toxic air pollutants as part of a regional air toxics study. The monitoring results for the Georgetown site were similar to the other five sites monitored within the Seattle urban area (EPA 2000, Ecology 2000). The cumulative cancer risk for monitored air toxics in Georgetown was 7.0 per hundred thousand individuals while the other sites ranged between 6.6 and 7.7 per hundred thousand. The monitored pollutant concentrations are partially the result of emissions from nearby industrial, airport, and roadway traffic sources. Approximately 60 percent of the air toxic risk estimated for Georgetown is from pollutants associated with transportation sources (traffic and aircraft). The greatest single air toxic risk was associated with diesel particulate emissions (PSCAA, 2002).

Localized Carbon Monoxide Concentrations

One-hour and eight-hour average CO concentrations for the 2002 existing conditions scenario were modeled using the same methodology as 2007 and 2030 predictions (refer to Table 5 and Table 6, respectively). Because consistent methodology and assumptions were utilized, modeled CO concentration for 2002 can be compared with those predicted for future alternative, to show the trend in air quality expected in the project area.

Table 5: Maximum One-Hour Average CO Concentrations

Intersection	Scenario				
	2002 Existing	2007 No Action	2007 Build	2030 No Action	2030 Build
N. 35 th Street / Fremont Avenue	11.3	10.0	10.0	7.3	7.7
N. 36 th Street / Fremont Avenue	NA	NA	9.6	NA	7.4
N. 36 th Street / Evanston Avenue	NA	NA	8.9	NA	7.1
N. 38 th Street / SR 99 Off-ramp	NA	NA	5.5	NA	5.0
N. 38 th Street / Bridge Way N.	NA	NA	NA	NA	5.9
Notes: NA = Not Applicable (the intersection would not be signalized under this alternative) Concentration values are in parts per million (ppm). The one-hour average NAAQS for CO is 35 ppm.					

Table 6: Maximum Eight-Hour Average CO Concentrations

Intersection	Scenario				
	2002 Existing	2007 No Action	2007 Build	2030 No Action	2030 Build
N. 35 th Street / Fremont Avenue	7.9	7.0	7.0	5.1	5.4
N. 36 th Street / Fremont Avenue	NA	NA	6.7	NA	5.2
N. 36 th Street / Evanston Avenue	NA	NA	6.2	NA	5.0
N. 38 th Street / SR 99 Off-ramp	NA	NA	3.9	NA	3.5
N. 38 th Street / Bridge Way N.	NA	NA	NA	NA	4.1
Notes: NA = Not Applicable (the intersection would not be signalized under this alternative) Concentration values are in parts per million (ppm). The eight-hour NAAQS for CO is 9 ppm.					

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Impacts

No Action Alternative

Construction

Bridge construction would not take place under this alternative; therefore, there would be no construction related air quality impacts.

Operation

Estimated worst-case CO concentrations under the No Action Alternative would be lower than existing conditions at the N. 35th Street and Fremont Avenue intersection in both the year 2007 and 2030 scenarios. The predicted lower CO concentrations are primarily due to reductions in vehicle emissions, as newer vehicles replace older, polluting vehicles. No exceedance of the one-hour average NAAQS of 35 ppm for CO was predicted under the No Action Alternative for either year 2007 or 2030 (Table 5). Additionally, no exceedance of the eight-hour average NAAQS of 9 ppm for CO was predicted at for the No Action Alternative (Table 6).

Bridge Approach Replacement Alternative

Construction

Air quality may decrease temporarily along detour routes with an increase in stop-and-go driving or an increase in vehicle idling time during partial bridge closures. Fugitive emissions from particulate matter less than 10 micrometers in size (PM₁₀) would be associated with demolition and construction of the bridge alternative.

PM₁₀ emissions would vary from day to day, depending on the level of activity, specific operations, and weather conditions. PM₁₀ emissions would depend on wind speed, and amount and type of operating equipment. Larger dust particles would settle near the source, and fine particles would be dispersed over greater distances from the construction site.

The quantity of particulate emissions would be proportional to the area of the construction operations and the level of activity. Based on field measurements of suspended dust emissions from construction projects, an approximate emission factor for construction operations would be 1.2 tons per acre of construction per month of activity (U.S. EPA, 1985). Emissions would be reduced if mitigation was performed.

There are businesses within 100 feet of the construction area for the proposed improvements. At that distance, fugitive PM₁₀ emissions from construction activities would be noticeable, if uncontrolled. Mud and particulates from trucks would also be noticeable if construction trucks would be routed through residential neighborhoods. Construction would require mitigation measures to comply with

Puget Sound Clean Air Agency (PSCAA) regulations that require dust control during construction and prevent the deposition of mud on paved streets (PSCAA Regulation 1, Article 9). Measures to reduce the deposition of mud and emissions of particulates are identified in the *Mitigation* section.

Removal of the existing bridge approach could disturb lead and chromium containing paint. The paint chips, if not properly controlled, could become fugitive dust.

In addition to particulate emissions, heavy trucks and construction equipment powered by gasoline and diesel engines would generate small particulates, CO, and NO_x in exhaust emissions. If construction traffic were to reduce the speed of other vehicles in the area, emissions from traffic would increase slightly while those vehicles are delayed. These emissions would be temporary and limited to the immediate area surrounding the construction site. It would contribute a small amount compared with automobile traffic in the project area, because construction traffic would be a very small fraction of the total traffic in the area.

Some construction phases (particularly during paving operations using asphalt) would result in short-term odors. These odors might be detectable to some people near the project site, and would be diluted as distance from the site increases.

Construction activities such as slash disposal, burning or emissions from asphalt plants, gravel plants and other temporary sources will not occur as part of this project.

Operation

The predicted worst-case CO concentrations under the Build Alternative for years 2007 and 2030 would not exceed the one-hour average NAAQS of 35 ppm for CO at any location (Table 5) or the eight-hour NAAQS of 9 ppm (Table 6). Vehicle emission factors will be higher in 2007 than later years; therefore, the analysis is conservative of potential impacts.

The proposed year 2007 Build Alternative is anticipated to have the highest CO concentration at the N35th Street and Fremont Avenue intersection. Between years 2007 to 2030, the emissions per automobile would decrease as a result of implementing new, planned emissions technology. With a lower emissions factor, air quality would improve, resulting in the 2030 bridge alternative having lower predicted CO concentrations than the 2007 bridge scenario in most locations.

The predicted maximum eight-hour average CO concentrations for the Build Alternative for the year 2007 and 2030 would not exceed the eight-hour average NAAQS CO of 9 ppm or the one-hour average NAAQS of 35 ppm for CO at any location.

Secondary and Cumulative Impacts

The air quality analysis described in this report was performed using projected traffic volumes for the future years. These projected traffic volumes incorporate anticipated traffic generation from planned development in the project area. Therefore, the air quality analysis includes the secondary and cumulative affects of the project and other traffic growth that would be associated with the project.

Mitigation

Construction

Air quality along detour routes may be affected by an increase in stop-and-go driving or an increase in vehicle idling time during partial bridge closures. A traffic mitigation plan will be implemented by the City of Seattle, which may help improve air quality along detour routes during construction. The mitigation plan does include the following measures:

- Remove Northbound Left Turn at Fremont Avenue/North 34th Street (AM Peak)
- Remove Eastbound Left Turn at Fremont Avenue/North 35th Street
- Extend Eastbound Left Turn at Fremont Place/Evanston/North 36th Street
- Add signal at Fremont Place/Evanston/North 36th Street
- Add signal at Fremont Avenue/North 36th Street
- Add signal at SR-99 Northbound Off-Ramp/Bridge Way/North 38th Street
- Reconfigure Evanston Avenue to two-way traffic south of North 36th Street

Particulate emissions (in the form of fugitive dust during construction activities) are regulated by PSCAA. Operators of fugitive dust sources would take reasonable precautions to prevent this dust from becoming airborne, and would maintain and operate the source to minimize emissions. Construction impacts could be reduced by incorporating the mitigation measures outlined in the Associated General Contractor of Washington Guidelines into the project's construction specifications. Possible mitigation measures to control PM₁₀, deposition of particulate matter, and emissions of CO and NO_x during construction are listed below:

- Spray exposed soil with water or other dust palliatives to reduce emissions of PM₁₀ and deposition of particulate matter.
- To reduce PM₁₀ and deposition of particulates during transportation, cover all trucks transporting materials, wet materials in trucks, or provide adequate freeboard (space from the top of the material to the top of the truck).
- To decrease deposition of particulate matter on area roadways, provide wheel washers to remove particulate matter that would otherwise be carried off-site.
- Remove particulate matter deposited on paved, public roads to reduce mud on area roadways.
- Route and schedule construction trucks so as to reduce delays to traffic during peak travel times. This would reduce secondary air quality impacts caused by a reduction in traffic speeds while waiting for construction trucks.
- Place quarry spall aprons where trucks enter public roads, to reduce mud track-out.
- Gravel or pave haul roads to reduce particulate emissions.
- Require appropriate emission-control devices on all construction equipment powered by gasoline or diesel fuel, to reduce CO and NO_x emissions in

vehicular exhaust. Use relatively new, well-maintained equipment to reduce CO and NO_x emissions.

- Plant vegetative cover as soon as possible after grading, to reduce windblown particulates in the area.
- Route construction trucks away from residential areas to minimize annoyance from dust.
- Containing and properly disposing of any chromium and lead based paints during removal of existing bridge would reduce the release of these elements into the environment.

Operation

Because no exceedances of NAAQS are predicted, no design or operational changes would be required.

Conformity Determination

City of Seattle projects must comply with project-level conformity criteria of the EPA Conformity Rule, and with WAC Chapter 173-420. Regionally significant projects must be included in a conforming Metropolitan Transportation Plan (MTP) and Transportation Improvement Plan (TIP) by the regional Metropolitan Planning Organization (MPO). The Fremont Bridge project does not need to be included operationally in the MTP and TIP because it maintains or replaces an existing regionally significant connection without substantially changing the capacity of the facility. The project must still meet the localized conformity requirements (WAC 173-420-120). As stated in 40 Code of Federal Regulation (CFR) Part 93, the following criteria must be met when determining project conformity. A brief summary of the project's conformity is discussed with each criterion (criteria are indicated by italics).

- *The conformity determination must be based on the latest planning assumptions.* CO concentrations were modeled at proposed signalized intersections or at intersections that experience a configuration change in the Fremont Bridge project corridor using the latest available traffic forecasts.
- *The conformity determination must be based on the latest emission estimation model available.* Air quality pollutant emission factors for analysis of the 2002 existing conditions, 2007 and 2030 bridge and no bridge scenarios were estimated using EPA's MOBILE 6.2 emission factor program using data inputs provided by the WADOE.
- *The MPO must make the conformity determination according to the consultation procedures of this rule and the implementation plan revision required by Section 51.396.* The Fremont Bridge project is exempt from this conformity requirement.
- *There must be a current conforming plan and a current conforming TIP at the time of project approval.* The Fremont Bridge project is exempt from this conformity requirement.
- *The project must come from a conforming transportation plan and program.* The Fremont Bridge project is exempt from this conformity requirement.
- *The FHWA project must not cause or contribute to any new localized (hot spots) CO or PM₁₀ violation in CO and PM₁₀ nonattainment or maintenance areas.* The project is located in a CO maintenance area. The project would not create any new regional violations or contribute to the frequency or severity of any existing violations of the NAAQS. The project area is in conformity for PM₁₀.
- *The FHWA project must comply with PM₁₀ control measures in the applicable implementation plan.* The area is in conformity for PM₁₀, so no implementation plan is required.

The Build Alternative would not alter capacity of any regionally significant facilities; therefore, it is exempt from regional conformity requirements. The project meets the local hot-spot conformity requirements. Both alternatives meet all requirements of 40 CFR Part 93 and WAC 173-420 and conform to the SIP.

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